The Institution of Engineering and Technology

The STEM Toys of Christmas

How To Guide

1. Dissolving Egg

Tools and Materials Required

- [ ] **Small toy e.g. plastic dinosaur**
- [ ] **180g baking soda**
- [ ] **Oil**
- [ ] **Citric acid**
- [ ] **Glitter**

Directions

- [ ] Add glitter to baking soda, mix thoroughly.
- [ ] Add 2 tbsp of citric acid, then 1 tsp of oil and mix well. This should make a dry and crumbly dough that sticks together if you press it. If it won't stick, then add more oil a tiny bit at a time.
- [ ] Press the mixture around your small toy until you have formed a good sized egg. Set aside to dry overnight (at least 10 hours).
- [ ] When you are ready to hatch the eggs, simply place in a tray or bathtub and add water!

Notes

- [ ] None of the ingredients in this egg should be consumed.

STEM Facts

When the baking soda and citric acid hit the water, they react and create Carbon Dioxide bubbles. This causes the fizzing and the disappearance of the egg.

2. Magnetic Slime

Tools and Materials Required

- **Magnetic powder** (iron filings)
- **Craft glue**
- **Liquid laundry detergent** (check it is Borax-free)
- **Neo magnets**

Directions

- Place glue in a bowl, stir in 3tsp of magnetic powder. Add a small amount of laundry detergent and stir in to form slime. Keep adding and stirring until you reach the desired texture (feel free to use your hands to mix).
- Then, simply use as normal and for an extra fun twist put your magnet close by and see how the slime reacts!

Notes

- Wash hands after making and each use.
- Keep in airtight container for continued use.
- Keep Neo magnets well away from electrical devices, particularly mobile phones.
- Please note that magnets should be handled carefully as it's easy to trap small fingers between them. They are also very dangerous if swallowed and should only be used under strict adult supervision. Accompanying instructions should be read carefully before use.
- Magnetic powder should not be consumed. Please supervise children when using the powder and resulting slime.
- Avoid any contact with eyes

STEM Facts

Magnets are objects that create magnetic fields. Iron is a ferrous metal, meaning it is attracted to magnets.

3. Marble Run

Tools and Materials Required

- **Foam pipe insulation** (20mm)
- **Silver duct tape**
- **Masking tape**
- **Marbles** (15mm)
- **Scissors**

Directions

- Cut the foam tubes in half and tape end to end, so you have a long run of tubing.
- Masking tape one end of the tubing to something high like a table or door handle. Have an experimental marble roll to see what happens.
- Next, experiment with creating a hill by placing an object under the tubing. Try another roll. What happens if you move the hill or make it taller?
- Now add a second hill. Again, explore what happens when you change heights and positions of the hills.
- Finally, use wrapping paper or toilet rolls to create tunnels around the tubes.

STEM Facts

At the top of the hill, the marble has potential energy. Gravity pulls the marble down the hill, turning the potential energy into kinetic energy (movement). The marble builds up momentum to get it up and over the next hill, and gravity pulls it down the other side.

Notes

- Marbles are a choking hazard and shouldn't be used unsupervised.
- Cutting should be done by an adult or under adult supervision.

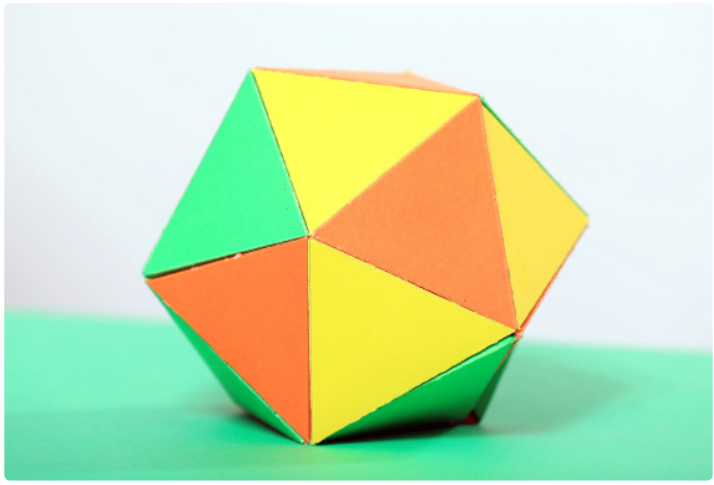
4. Icosahedron Bauble

Tools and Materials Required

- **Printer, compass or round object**
- **Coloured paper** (10 sheets)
- **Scissors**
- **Glue stick or double sided tape**
- **Ribbon**

Directions

- If you have a printer, print out our template PDF. If you don't have a printer, use a compass or round object to draw out 20 circles.
- Cut out your circles. They don't have to be perfect, just try to make sure they all end up roughly the same size.
- Fold the circles into equilateral triangles – if you've printed out our template just follow the lines.
- Stick five of the triangles together in a circle using the flaps. Arrange them first so you can see how they fit together.
- Repeat this process, creating another circle from five triangles.
- Take the remaining 10 triangles and arrange them in an alternating pattern (one facing up, one facing down) so they form a long strip. Stick them together.
- Once the strip is complete, attach the first flap to the last flap to create a ring.
- Attach one of the circles to the bottom of your triangle ring by matching up the flaps and sticking them in place. You will now have a bowl shape.
- Finally, attach your remaining circle to the top of your bowl (this bit is quite tricky), again matching up and attaching the flaps. Now you have your finished Icosahedron.
- Add a ribbon loop to display it as a giant bauble!



STEM Facts

Equilateral triangles have equal lengths each side because of this, it is perfectly symmetrical (you can fold it down the middle in any direction and both sides of the fold will match). Equilateral triangles might seem simple but they are very useful in solving complex mathematical equations.

The icosahedron is a great example of an equilateral triangle being used to make more complicated things. An icosahedron contains 20 identical equilateral triangles. It is a regular polyhedron. That means that it is a solid, three-dimensional shape made of flat shapes with straight edges and sharp corners. There are lots of different polyhedrons. Because the icosahedron is regular, it is also symmetrical, just like the equilateral triangles it is made from.

The icosahedron is one of the Platonic solids. These are five 3D shapes named after the Greek Philosopher Plato. The ancient Greeks studied the Platonic solids and believed they were connected to natural materials. The icosahedron was associated with water, because it forms round droplets.

Notes

- Cutting should be done by an adult or under adult supervision.
- Attaching the second circle is tricky and may require assistance.

5. Balloon Boat

Tools and Materials Required

- **A balloon**
- **Extra thick kitchen sponge**
- **Wide plastic tubing**
- **Small rubber band**
- **Ruler**
- **Scissors**
- **Felt tip pen**
- **Tub or container to test**

Notes

- Cutting should be done by an adult or under adult supervision.
- Water play should be supervised by an adult at all times.

STEM Facts

The stretchy balloon wants to go back to its uninflated shape, so it puts pressure on the air inside it, forcing it out. The force of the air leaving the balloon pushes the boat through the water.

The slit in the sponge holds the balloon neck quite tightly, only allowing the air to escape slowly, so that the boat is gently powered for a while, rather than strongly powered for a second or two!

The tube directs the flow of air, which affects the direction the boat is pushed in. If the tube is facing the back of the boat, the boat will go forward. If it is pointing in another direction, it will most likely go sideways.

The shape of the boat affects how it moves. The pointed front end makes it easier for the boat to move through the water, so the boat will go further if the tube is pointed towards the back than if you try to make the boat move in other directions.

Directions

- Draw two diagonal lines to create an equal sided point at one end of the sponge. This will be the front of your boat. Once you are happy that the shape is even, cut it out.
- Cut a small slit at the centre of the boat.
- Blow your balloon up and let the air out to stretch it.
- Poke the neck of the balloon through the slit in the sponge. Stretch the neck of the balloon around the plastic tubing. You may need to secure it with a rubber band if it's a bit loose.
- Get your water container ready.
- Inflate the balloon by blowing through the tube. Put your thumb over the end of the tube to stop air escaping.
- Put the boat into the water, making sure the tube is pointing to the end of the boat. Take your thumb off the tube and watch the boat go!

6. Bouncy Balls

Tools and Materials Required

- **Access to a tap**
- **A packet of party balloons**
  (15-30 balloons per ball – not suitable for children who are still putting objects in their mouths)
- **Scissors**
- **Two sets of hands!**

Directions

- Carefully fill the balloon with water until it fits neatly in the palm of your hand.
- Standing over the sink, pinch the neck of the balloon, and then tie a knot. Make sure there isn't any air in the balloon before you tie.
- Trim the neck of the balloon. Be careful to leave a little room above the knot so it doesn't come undone later.
- Cut the neck off the rest of your balloons.
- Stretch each balloon and put the water filled balloon inside, then stretch out what is left of the neck and cut it so that where it snaps back there is no neck left. You may need help with this, it can be tricky!
- Repeat this process until you have made at least 15 layers. For a really bouncy ball use 30 layers.
- To ensure an even shape, turn the ball each time you wrap a balloon around it, so that it doesn't have any weak points.

STEM Facts

When an object collides with something hard, its shape alters. For example if an object hits a wall, the side in contact with the wall will become flat. But, if the material used to make a ball is elastic (like a nice stretchy balloon), the ball will return to its original shape, causing it to bounce. The more elastic the material, the bigger the bounce.

Notes

- Cutting should be done by an adult or under adult supervision.
- Use of this toy should be supervised to avoid damage to surroundings.

7. Smartphone Projector

Tools and Materials Required

- **A small cardboard box** (approx 8in x 6in x 12in)
- **A magnifying glass**
- **Scissors or a craft knife** (for adult use or under close supervision for older children)
- **Tape**
- **A smart phone**

Directions

- Turn your box so that one of the narrow sides is facing up. Put the magnifying glass in the middle and draw around it.
- Cut a hole in the box that is slightly smaller than the circle (the box should hold the magnifying glass, without it falling through).
- Cut the circle of cardboard into a wide strip. Form it into a triangular tube and secure with tape. This will be the smartphone stand.
- Tape the phone stand into the box so that the phone will be in line with the magnifying glass (the cut out hole). It should be at least 5-6 inches from the glass.
- Place the magnifying glass on the box so the glass aligns with the cut out hole. Secure with tape.
- Set up a video on your phone (lock the phone onto landscape orientation) and place it on the stand inside the box.
- Darken the lights and point the projector at a blank white wall. Play with the best distance from the wall to get a sharp image.
- You will notice that the image is upside down. Turn the phone upside down to project the image correctly.

STEM Facts

The lens is convex (its sides bend outwards). Light passing through the lens is also bent outwards, which is why the projected image is bigger than the one on the smartphone.

As the lens bends the light, it also flips the image upside down. This is why we need to turn the phone upside down to get a right side up projected image. The lens in your eye works the same way, but our brain flips it up the right way again.

Notes

- Cutting should be done by an adult or under adult supervision.
- Some apps do not allow you to lock the screen orientation, if you are having problems try a different video player.

8. Living Gingerbread House

Tools and Materials Required

- **Four plain sponges**
- **Scissors**
- **Toothpicks**
- **Glue gun or craft glue** (optional)
- **Small plate**
- **Small dish**
- **Seeds**
- **Spray bottle** (clean)

Notes

- Cutting and gluing should be done by an adult or under adult supervision.
- Seeds should not be consumed under any circumstances.
- Cocktail sticks are sharp, be careful!
- If using a glue gun, this should be done by an adult or under supervision.

Directions

- Choose a sponge to be your base.
- Choose two more sponges to be the walls. Cut one sponge in half across the longest side (i.e. make two regular rectangles, not two long strips) and set aside.
- Cut your second sponge in the same way, and then cut the halves in half again (also across the longer side). You will only need two of these pieces, so set two aside.
- Cut your last sponge in half in the same way as the others. These will be your roof.
- Put your base sponge onto the plate. Work out how you will assemble your walls before you attach them: you should have two large rectangles and two smaller rectangles, all of the same height. Arrange them into a box shape.
- Insert cocktail sticks into the sides and bottom of your sponge walls, so that about half an inch of the stick is still visible. Push the sponge walls down onto the sponge base and into each other so they are secured in place by the cocktail sticks. Attach the roof in the same way. Place your finished house onto the plate.
- If your house is a bit wobbly, you can secure it using a glue gun or some craft glue. In both cases, allow time for the glue to dry and set before you move on to the next stage.
- Next, you need to cover the house with seeds. You can use mustard or cress but there are many fast sprouting seeds, so have fun and experiment!
- First, dab some water onto the roof of your house. Put a tablespoon of seeds into a small dish and mix with a little water. Spread the seeds onto the roof.
- Pour a little water onto the plate so the sponge base can soak it up. Check the sponge is nice and moist. Then sprinkle the seeds onto the base.
- Leave in a warm, bright spot for the seeds to germinate. Spray the house with water using a spray bottle each day, and pour a little water over the house if it feels dry. In a few days the seeds should start to sprout, in a week they should be well grown.

STEM Facts

Each seed holds all of the food and instructions needed to build a new plant. When the seed is given warmth, moisture and light it will grow.

You will see that the seeds grow better in some places than others. Some places on the house are naturally drier, some get less light and some get less heat. This affects how well the seeds grow.

When it first starts to grow, the seed uses the food it already has inside for energy. It soaks up water, which allows it to break down the food and create enzymes. The enzymes tell the seed to send out roots and germinate.

The roots break through the outside of the seed (this layer is called the seed coat) and grow downwards in search of food and water. They also hold the plant securely in place.

Once roots are in place, the seed starts to grow a stem. This is called germination. The stem continues to grow, and the plant begins to make its own food from nutrients collected by the roots and through photosynthesis, which is where plants collect sunlight and use it to make food.

9. Kaleidoscope

Tools and Materials Required

- ☐ **Toilet paper roll**
- ☐ **Mirror card**
- ☐ **Scissors**
- ☐ **Tape**
- ☐ **White card**
- ☐ **Bendy straw**
- ☐ **Wrapping paper**
- ☐ **Glue stick**
- ☐ **Paint/markers**

Directions

- ☐ First, decorate the outside of your toilet paper roll. Leave to dry, if required.
- ☐ Cut your mirror card: it should be the length of your toilet roll and 11.5 cm wide. Fold into three x 3.5cm strips with a 1cm excess (it may help to measure and score it first). Roll into a triangular tube, tape in place and slide into the toilet roll.
- ☐ Cut the top off the straw, including the bendy section. Tape the piece with the bendy section to one end of your toilet roll, with the bendy part hanging over the end of the roll.
- ☐ Trace a 5cm diameter circle onto your card-stock. Use a sharp pencil to poke a small hole in the middle of the circle. Decorate your circle (we suggest some wrapping paper collage).
- ☐ Push the bendy end of the straw through the hole in your circle (the decoration should face towards the roll). The ridges on the bendy part of the straw should hold the circle in place.
- ☐ Look inside and spin for patterns!

Notes

- ☐ Cutting and scoring should be done by an adult or under adult supervision.

STEM Facts

Kaleidoscopes have been around since the early 1800s. The internal mirrors bounce light off each other, creating amazing mirrored patterns. As the circle rotates, the designs move and new patterns are created.

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How To Guide

All projects should be completed with due care and attention under adult supervision